STUDIES ON MALE STRIDULATORY APPARATUS OF *KUWAYAMAEA* MATSUMURA & SHIRAKI AND A DESCRIPTION OF A NEW SPECIES (ORTHOPTERA: PHANEROPTERIDAE)

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Abstract The paper reports male stridulatory apparatus of *Kuwayamaea sapporensis* Matsumura & Shiraki, 1908, *Kuwayamaea chinensis* (Brunner-Wattenwyl, 1878), and *Kuwayamaea longipennis* sp. nov. The three species differ from one another in male stridulatory apparatus. The specimens are deposited in Institute of Zoology, Shaanxi Normal University.

Key words Orthoptera, Phaneropteridae, Kuwayamaea, male stridulatory apparatus, new species

The genus *Kuwayamaea* was established by Matsumura & Shiraki, 1908[1]. Type species is *K. sapporensis* Matsumura & Shiraki, 1908. Ragge (1961) thought the name *Kuwayamaea* is a junior synonym of the name *Ducetia* Stal, 1874, and the name *Kuwayamaea sapporensis* Matsumura & Shiraki is a junior synonym of *Ducetia chinensis* (Brunner- Wattenwyl, 1878)[2~3]. Furukawa (1963)[4], Gorochov (1993)[5] and Liu (1993)[6] studied the genus *Kuwayamaea* Matsumura & Shiraki, 1908. They thought the genus *Kuwayamaea* Matsumura & Shiraki is similar to the genus *Ducetia* Stal, but differs from it in male stridulatory area of right tegmen, the point of male cerci, and the end of male genital plate. Now this point of view is supported by most scholars. The authors have studied the male stridulatory apparatus of three species of the genus Kuwayamaea. The three species differ in male files and their teeth.

1 Materials and methods

The specimens studied are deposited in Institute of Zoology, Shaanxi Normal University.

The left tegmen was washed with 75% and 100% alcohol several times. They were air-dried and coated with gold. The morphology of the files and the teeth was studied with S-570 Hitachi scanning electrom microscope.

2 Results

The male stridulatory apparatus, as other bushcrikets, consists of file and plectrum. The file

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Table 1 Locality and number of samples studied
表1 研究的标本数量和采集地点

Species 种类	Locality of specimens collected 标本采集地点	Number of specimens studied 标本数量
Kuwayamaea sapporensis 札幌桑螽	Wudang Mountain, Hubei	2
	Zhouzhi, Shaanxi	3
Kuwayamaea chinensis 中华桑螽	Anji, Zhejiang	4
Kuwayamaea longipennis sp. nov. 长翅桑螽，新种	Lu Mountain, Jiangxi	3

is a modified Cu_2 vein on the underside of the left tegmen. The plectrum is formed by the thickened internal edge of the right tegmen. The file is composed of many teeth. The number, morphology and arrangement of the teeth of the file is obviously different in males of different species.

***Kuwayamaea sapporensis* Matsumura & Shiraki**, 1908 (Plate I: 3-4)

File of male curved, separated into three parts. Every part differing from one another in distance among teeth and morphology of teeth. Top of teeth in middle part of file wide. The end of teeth acuted, the other slope-shaped. File with 140～150 teeth, about 2.2 mm long. Teeth in middle part of file 160 μm long. Distance among teeth in middle part of file about 65 μm.

***Kuwayamaea chinensis* (Brunner-Wattenwyl**, 1878) (Plate I: 1-2)

File of male straight, only slightly curved in the ends, separ-ated into three parts. In anterior part, distance among teeth narrow. It slightly wider in middle part of file. In posterior part, teeth very wide. Distance among teeth the widest. Teeth in middle part slightly curved, the ends of teeth acuted. File with about 170 teeth, 2.1 mm long. Teeth in middle part 90 μm long. Distance among teeth in middle part about 21 μm.

***Kuwayamaea longipennis* sp. nov.** (Plate I: 5-6, Figs. 1～7)

Holotype ♂ Lu Mountain, Jiangxi Province, China. August 1, 1988, collected by Zhemin Zheng

Other material studied: Paratype 2 ♂, 2♀. Same data as holotype.

Description. Male body mediun size. Fastigium of vertex narrow, triangular, with wide longitudinal sulcus. Eye elliptical, comparatively small.

Pronotum wide and short. Metazona flat. Anterior margin slightly concave, posterior margin semicircular, with a thin median carina, without lateral carinae. Humeral sinus not pronounced. Lateral lobes length longer than height. Procoxa without spine. Fore tibia with dorsal longitudinal sulcus, with internal and external distal spurs. Fore tibia tympanic organ open, elliptical. Pro-

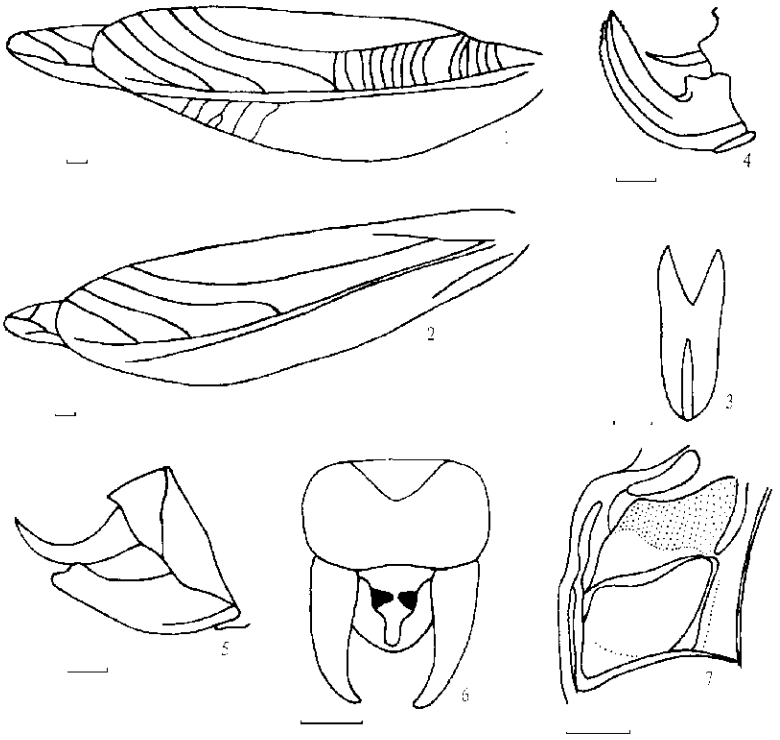

Fig.1～7　*Kuwayamaea longipennis* sp. nov.

1. ♂Tegmen, lateral view; 2. ♀ Tegmen, lateral view; 3. ♂Subgenital plate, ventral view; 4. ♀ End of abdomen, lateral view; 5. ♂End of abdomen, lateral view; 6. ♂End of abdomen, dorsal view; 7. ♂Mirror, dorsal view.

Scale bar is 1 mm

图 1～7　长翅桑螽 *Kuwayamaea longipennis* 新种

1. ♂前翅，侧面观；2. ♀前翅，侧面观；3. ♂下生殖板，腹面观；4. ♀腹末端，侧面观；5. ♂腹末端，侧面观；6. ♂腹末端，背面观；7. ♂镜膜，背面观。

各比例线段均代表 1 mm

meso-and meta-femora with spines. Knee lobi with two spines. Tegmen more longer, length three times as width, reaching the end of hind femur. R vein with 4 branch veins, these veins parallel. Hind wing longer than tegmen.

10th abdominal tergite more wider, posterior margin truncate. Anterior part with V-shaped sulcus. Anal plate tongue-shaped. Cerci horned, the distal part curved upward, pointed. Subgenital plate stout, anterior part triangular concave, the end convex, with narrow stripe-shaped median feebly sclerotized field at distal part, and a pair of stout sclerotized hook at dorsal apex.

Cu_2 vein of left tegmen stout, slightly curved. File distinctly curved. Teeth of file alike. Distance of among teeth about equal. Teeth board-shaped. Mirror of right tegmen separated by stout vein. File with 108～115 teeth, and 2.6 mm long. Teeth of middle part about 120 μm long. Dis-

tance among teeth in middle part 15 μm. Two rows of small teeth on outside of file.

Coloration. Body yellowish brown, possible green in life. Eye brown. Stridulatory field brown. Tegmen with 4～5 circular brown spots. The apex of cerci dark brown.

Female. Hind wings extending beyond tegmina (3.5～4 mm). Cerci conical, slightly curved. Ovipositor curved upward. The end with some small teeth. Subgenital plate short triangular, apex blunt, with a thin median longitudinal sulcus.

Measurements. Length of body ♂20.5～21.0 mm, ♀ 19.5～20.0 mm; Lenght of pronotum ♂4.2～4.7 mm, ♀5.0 mm; Length of tegmen ♂26.0～30.0 mm, ♀24.0～28.0 mm; Length of hind femur ♂24.0～27.0 mm, ♀25.0～27.0 mm; Length of ovipositor♀6.0～8.0 mm.

Comparision. The new species is similar to *K. sapporensis* Matsumura & Shiraki, and *K. chinensis* (Brunner-Wattenwyl,), but differs from the former in male file , teeth, subgenital plate and female hind wing; and from the latter in male file and teeth.

3 Discussion

Investigations of male stridulatory apparatus have been used to compare phylogenetic relationships between species of the genus *Kuwayamaea*. Ragge (1969, 1980), Huxley (1970), Emsley et Nickle (1969), Bailey (1979), Pitkin (1980), Heller (1988) *et al*. studied male stridulatory apparatus of some tettigoniids. They stated that the apparatus appears completely different among species in the morphology of the file, the number and arrangement of the teeth.

The results of this survey have indicated that the different structure of the male stridulatory apparatus among species is sufficiently to be used as a taxonomic character. The male stridulatory apparatus may be a reliable character at the species level. Intraspecific variation was noted primarily with the number of the teeth, the length of the file and the length of the teeth. The species are primarily different in the morphology of the file, the morphology and the arrangement of the teeth. More specimens of a species need to be observed to determine the extent of individual variation.

In general, communication in Tettigonioidea is that the male sings to attract the female, and the female moves to the male. A species emits song different from that of other species. The difference in songs is usually reflected by morphological structure associated with sound production. In those closely related species, that may be the only character for distinguishing those species. In those species, no obviously difference appears in the females.

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桑螽属雄性发声器的研究及一新种记述
（直翅目：露螽科）

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摘要　报道了桑螽属三种雄性发声器结构并记述一新种长翅桑螽 *Kuwayamaea longipennis* sp. nov.，该新种与札幌桑螽 *Kuwayamaea sapporensis* Matsumura *et* Shiraki，1908 和中华桑螽 Kuwayamaea *chinensis*（Brunner，1878）相似，同前者的主要区别：雄性声锉和发声齿不同，下生殖板端部分枝，雌性后翅长于前翅；同后者的主要区别：雄性声锉和发声齿显著不同。模式标本保存于陕西师范大学动物研究所。

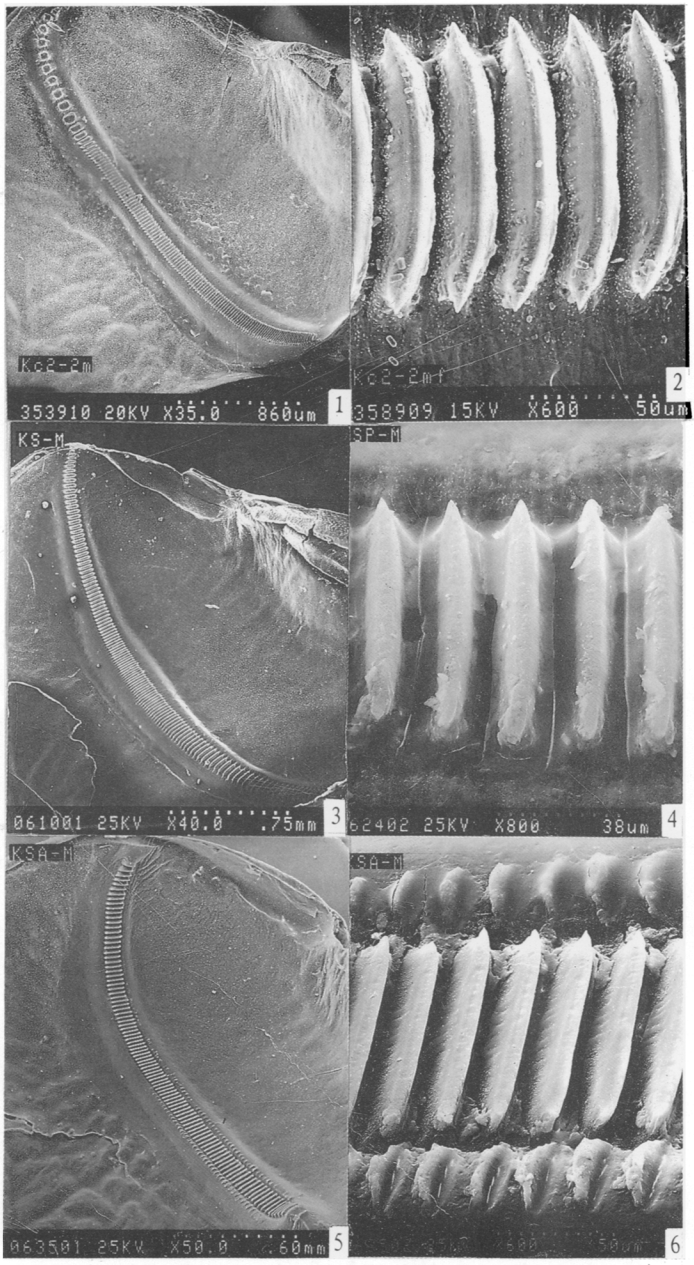
关键词　直翅目，露螽科，桑螽属，雄性发声器，新种

图版说明　（Explanation of Plates）

图版Ⅰ　（Plate Ⅰ）

Male stridulatory apparatus of *Kuwayamaea* Matsumura & Shiraki. 1，3，5•Male stridulatory files；2，4，6•Male stridulatory teeth. 1-2•*K. chinensis*（Brunner-Wattenwyl，1878）；3-4•*K. sapporensis* Matsumura & Shiraki，1908；5-6•*K. longipennis* sp. nov.

桑螽属 *Kuwayamaea* 雄性发声器 .1，3，5•♂发声锉；2，4，6•♂发声齿；1-2•中华桑螽 *K. chinensis*（Brunner-Wattenwyl，1878）；3-4•札幌桑螽 *K. sapporensis* Matsumura & Shiraki，1908；5-6•长翅桑螽 *K. longipennis*，新种



图版说明见文后(Explanation at the end of the text)